



PRODUCT MANUAL

Lyrion Series IDE

ST760211DE

ST760211DEG

ST730212DE

ST730212DEG

Revision status summary sheet

Revision	Date	Sheets Affected
Rev. A	01/04/07	Initial Release.
Rev. B	01/31/07	5.
Rev. C	03/01/07	3-4, 7, 10 and 17.

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One gigabyte, or GB, equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting. Quantitative usage examples for various applications are for illustrative purposes. Actual quantities will vary based on various factors, including file size, file format, features and application software. Seagate reserves the right to change, without notice, product offerings or specifications.

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1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following Seagate® Lyrion Series® IDE drives:

- ST760211DE-60GB, ST730212DE-30GB disc drives with an IDE interface.
- ST760211DEG-60GB, ST730212DEG-30GB disc drives with an IDE interface. These models incorporate an additional free-fall sensor for robust drop performance.

These drives provide the following key features.

- 3,600-RPM spindle speed and a 2-Mbyte buffer combined for superior read/write performance.
- Quiet operation. Fluid Dynamic Bearing (FDB) motor.
- Perpendicular recording heads and EPRML technology, which provide the drives with increased areal density.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- 1500 G nonoperating shock, and 600 G operating shock.
- SeaTools™ diagnostic software performs a drive self-test that eliminates unnecessary drive returns.

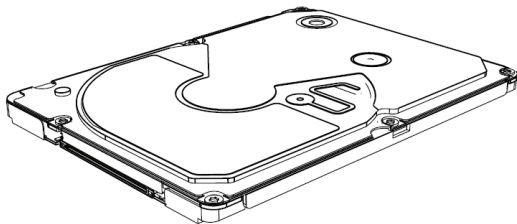


Figure 1. Lyrion Series (IDE interface) disc drive

1.1 Disclaimer

Seagate Technology LLC makes no warranties whatsoever, including any warranty of merchantability, non-infringement, fitness for any particular purpose, or any warranty otherwise arising out of any proposal, specification or sample. Seagate may not be held liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including, but not limited to, loss of use, data, or profits; procurement of substitute goods or services; or business interruptions) however caused and on any theory of liability, whether in contract, strict liability, or tort (including negligence or otherwise) arising in any way from the use of this kit, even if advised of the possibility of such damage.

1.2 Drive care

Do not use the Lyrion Series disc drives outside of the ranges of environmental conditions found in Section 2.8, "Environmental specifications." Doing so may void the warranty of the Lyrion Series disc drive.

2.0 Drive specifications

Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, and nominal power. For convenience, the phrases *the drive* and *this drive* are used throughout this manual to indicate ST760211DEG, ST760211DE, ST730212DEG AND ST730212DE model drives.

2.1 Overview

The specifications listed in this table are for quick reference. For details on specification measurement or definition, see the appropriate section of this manual.

Table 1: Specifications

Drive specification	ST760211DE, ST760211DEG	ST730212DE, ST730212DEG
Formatted Gbytes	60	30
Guaranteed sectors	117,210,240	58,605,120
Bytes per sector (logical)	512	
Cache (Mbytes)	2	
Recording density, BPI (bits/inch average)	1,025,000	
Track density, TPI (tracks/inch average)	165,000	
Areal density (Gbits/inch ² average)	169	
Spindle speed (RPM)	3,600	
Internal data transfer rate OD (Mbits/sec max)	350	
Sustained data transfer rate OD (Mbytes/sec)	24.5	
I/O data-transfer rate (Mbytes/sec max)	66.7 (UDMA 4)	
ATA data-transfer modes supported	PIO modes 0–4; Multiword DMA modes 0-2; Ultra DMA modes 0–4	
Height	5.0 + 0.15 mm(0.1968 + 0.006 inches)	
Width	54.0 +/-0.3 mm (2.1260 +/-0.0118 inches)	
Length	71.0 +/-0.3 mm (2.7953 +/-0.0118 inches)	
Weight	48.0 gm - 0.1058 lb. (typ)	
Average latency (msec)	8.3	
Power-on to ready (sec typical)	1.8	
Standby to ready (sec typical)	1.8	
Startup power (peak at 3.3v) (maximum RMS in 10ms window)	1.15 W	
Read/write power (typical 3.3V)	1.0/0.9 W	
Performance idle power (typical 3.3V)	0.5 W	
Low power idle power (typical 3.3V)	0.3 W	
Standby/Sleep power (typical 3.3V)	0.08 W	
Voltage tolerance (including noise)	3.3V ± 5%	

Table 1: Specifications

Drive specification	ST760211DE, ST760211DEG	ST730212DE, ST730212DEG
Ambient temperature	0° to 60°C (operating) –40° to 70°C (nonoperating)	
Temperature gradient (°C per hour max)	20°C (operating) 30°C (nonoperating)	
Relative humidity (noncondensing)	5% to 90% (operating) 5% to 95% (nonoperating)	
Relative humidity gradient	30% per hour max	
Wet bulb temperature (°C max)	33°C (operating) 40°C (nonoperating)	
Altitude, operating	–121.96 m to 3,048 m (–400 ft to 10,000+ ft)	
Altitude, nonoperating (below mean sea level, max)	–121.96 m to 12,192 m (–400 ft to 40,000+ ft)	
Shock, operating (Gs max at 2 msec)	600	
Shock, nonoperating (Gs max at 1 msec)	1500	
Vibration, operating (max displacement may apply below 10 Hz)	1.0 Gs (0 to peak, 10–500 Hz) @ 2 oct/min sweep rate	
Vibration, nonoperating (max displacement may apply below 22 Hz)	5.0 Gs (0 to peak, 10–500 Hz) @ 0.5 oct/min sweep rate	
Idle sound power (bels) (typical)	1.6	
Operational sound power (bels) (typical)	2.2	
Nonrecoverable read errors	1 per 10 ¹⁴ bits read	
Load/Unload (LUL) cycles	300,000 software-controlled 20,000 power loss	
Warranty	Per agreement	

2.2 Formatted capacity

Model	Formatted capacity	Guaranteed sectors	Bytes per sector (logical)
ST760211DE ST760211DEG	60 Gbytes	117,210,240	512
ST730212DE ST730212DEG	30 Gbytes	58,605,120	512

LBA mode addressing

When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to $n-1$, where n is the number of guaranteed sectors as defined above.

2.3 Default logical geometry

Model	Cylinders	Heads	Sectors
ST760211DE ST760211DEG	116,280	16	63
ST730212DE ST730212DEG	58,149	16	63

2.4 Recording and interface technology

Technology	Specification
Interface	IDE (Parallel ATA)
Recording method	Perpendicular Magnetic Recording
Recording density BPI (bits/inch average)	1,025,000
Track density TPI (tracks/inch average)	165,000
Areal density (Gbits/inch ² average)	169
Spindle speed (RPM) ($\pm 0.2\%$)	3,600
Internal data-transfer rate OD (Mbits/sec max)	350
Sustained data transfer rate OD (Mbytes/sec max)	24.5
I/O data-transfer rate (Mbytes/sec max)	66.7 (UDMA 4)
Cache buffer (Mbytes)	2

2.5 Physical characteristics

Height	(mm) (inches)	5.0 + 0.15 0.1968 + 0.006
Width	(mm) (inches)	54.0 +/-0.3 2.1260 +/-0.0118
Length	(mm) (inches)	71.0 +/-0.3 2.7953 +/-0.0118
Typical weight	(grams) (pounds)	48.0 (typ) 0.1058 lb. (typ))
Interface Connector		40-way ZIF

2.6 Time to ready

Time to ready	Typical
Power-On to Ready (sec)	1.8
Standby to Ready (sec)	1.8

2.7 Power specifications

The drive receives DC power (+3.3V) through the ZIF connector (IDE interface).

2.7.1 Power consumption

Power requirements for the drives are listed in the table on page 7. Typical power measurements are based on an average of drives tested, under nominal conditions, using +3.3V input voltage at 25°C ambient temperature.

- **Startup mode**

Startup power is measured from the time of power-on to the time that the drive spindle reaches operating speed.

- **Seek mode**

During seek mode, the read/write actuator arm moves toward a specific position on the disc surface and does not execute a read or write operation. Servo electronics are active. Seek power is measured based on three random seek operations every 100 msecs.

- **Read/write mode**

Read/write power is measured with the heads on track, while the head is reading/writing from/to disc. It is performed with 100 percent duty cycle of read/write operation.

- **Performance Idle mode**

During Performance Idle mode, the heads are on track but no reading or writing is done. The spindle motor is spinning at full speed.

- **Low power idle mode**

During Low power Idle mode, the heads are unloaded but the spindle motor is spinning at full speed. Servo and read/write electronics are in powered down mode.

- **Standby / Sleep mode**

During Standby/Sleep mode, the spindle motor is not spinning, and the servo and read/write electronics are in powered down mode.

Table 2: DC power

Power Consumption at 3.3V	Average (W)
Startup (max*)	1.15
Read	1.0
Write	0.9
Performance idle (typical)	0.5
Low power idle (typical)	0.3
Standby/Sleep (typical)	0.08

*Maximum is the average of the peak value in 10 msec window

2.7.1.1 Typical current profile

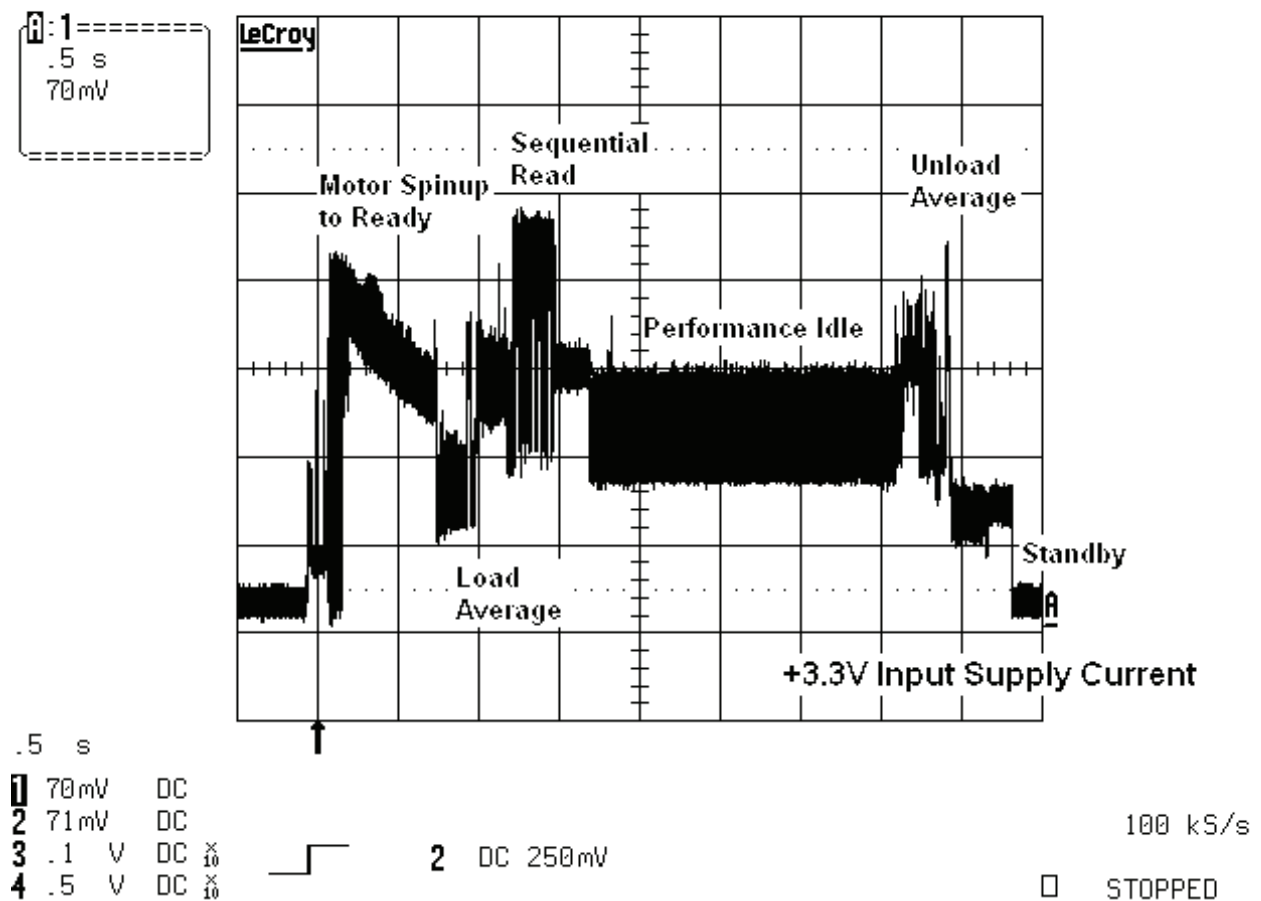


Figure 2. Typical 3.3V startup and operation current profile

2.7.2 Conducted noise

Input noise ripple is measured at the host system power supply across an equivalent 15-ohm resistive load on the +3.3 volt line.

Using 3.3-volt power, the drive is expected to operate with a maximum of 70 mV peak-to-peak square-wave injected noise at up to 20 MHz.

Note. Equivalent resistance is calculated by dividing the nominal voltage by the typical RMS read/write current.

2.7.3 Voltage tolerance

Voltage tolerance (including noise):

3.3V \pm 5%

2.7.4 Power-management modes

The drive provides programmable power management to provide greater energy efficiency. The drive features the following power-management modes:

Table 3: Power-management modes

Power modes	Heads	Spindle	Buffer
Active (read/write/seek)	Tracking	Rotating	Enabled
Idle, performance	Tracking	Rotating	Enabled
Idle, low power	Parked	Rotating	Disabled
Standby/Sleep	Parked	Stopped	Disabled

- **Active mode**

The drive is in Active mode during the read/write and seek operations.

- **Performance idle mode**

The drive enters this mode once the read/write/seek activity is completed. The buffer remains enabled, and the drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Low power idle mode**

Drive enters Low Power Idle mode from Performance Idle mode when the Advanced Power Management Level is set between 80h and FDh, and the Idle timer reaches 2 seconds (default setting). Disc is spinning and heads are parked and drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Standby/Sleep mode**

The drive enters Standby mode when the host sends a Standby Immediate command. When the Advanced Power Management Level is set lower than 80h (default setting), the drive enters the Standby state after 2 seconds of interface inactivity. If the host has set the standby timer, the drive may also enter the Standby mode after the expiry of the standby timer. The standby timer can be set using the Standby or Idle command. In Standby mode, the drive buffer is disabled, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disc access is necessary.

2.8 Environmental specifications

2.8.1 Ambient temperature

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Actual drive case temperature should not exceed 70°C (158°F) within the operating ambient conditions. Case temperature of the drive operating at 60°C ambient may hit a maximum of 70°C at certain parts of the casing.

Above 1,000 feet (305 meters), the maximum operating temperature is derated linearly by 1°C every 1000 feet.

Operating	0° to 60°C (32° to 140°F) (70°C max case temperature)
Nonoperating	–40° to 70°C (–40° to 158°F)

2.8.2 Temperature gradient

Operating	20°C per hour (36°F per hour max), without condensation
Nonoperating	30°C per hour (54°F per hour max), without condensation

2.8.3 Humidity

2.8.3.1 Relative humidity

Operating	5% to 90% noncondensing (30% per hour max)
Nonoperating	5% to 95% noncondensing (30% per hour max)

2.8.3.2 Wet bulb temperature

Operating	33°C (91.4°F max) [1]
Nonoperating	40°C (104°F max) [2]

[1] Operating: Wet bulb temperature is calculated by the operating Temperature and the Relative Humidity levels.

[2] Nonoperating: Wet bulb temperature is calculated by the nonoperating Temperature and the Relative Humidity levels.

2.8.4 Altitude

Operating	–121.96 m to 3,048 m (–400 ft to 10,000+ ft)
Nonoperating	–121.96 to 12,192 m (–400 ft to 40,000+ ft)

2.8.5 Shock

All shock measurements in this section are carried out at drive level. For all linear shock test, operating or nonoperating, the input shock level is measured at the frame of the drive at the specific location as indicated in Figure 3 below.

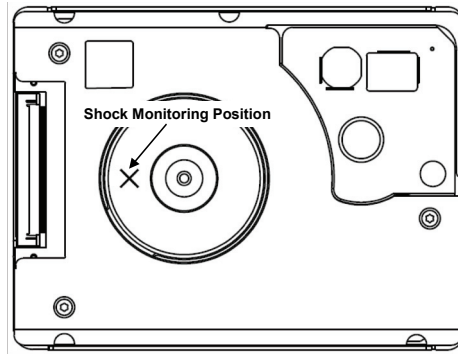


Figure 3. Location where tri-axial accelerometer will be placed on Lyrion Series drives

All shock test cover all the 6 directions, +/- x, y and z axes. The drive axis definition is shown in Figure 4 below.

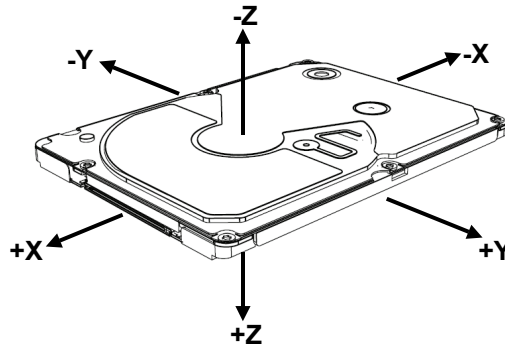


Figure 4. Drive axis definition for Lyrion Series drives

2.8.5.1 Operating shock

The drive is subjected to 10 shocks for each direction. During the shocks, there must be a minimum delay of 3 seconds between shock pulses. Soft errors and automatic retries are allowed during the test. No data loss or permanent damage occurs during a half sine shock pulse of:

600 G, 2 msec

2.8.5.2 Nonoperating shock

The nonoperating shock level that the drive can experience without incurring any physical damage when subsequently put into operation is 1500 Gs. The same applies for shock levels of 1500 G, 1 msec pulse duration on fresh drives for each level.

2.8.6 Vibration

All vibration specifications assume that the drive is mounted securely in a fixture that does not have fixture resonances in the frequency test range.

2.8.6.1 Operating sweep sine vibration

The following lists the maximum operating sweep sine vibration levels that the drive may experience while meeting the performance standards specified. It consists of a forward and backward sweep from 10 Hz to 500 Hz to 10 Hz. The drive operates without a hard error while being subjected to the following vibration levels.

10 Hz to 500 Hz @ 2 oct/min	1.0 Gs (0 to pk). Maximum displacement may apply below 10 Hz.
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2.8.6.2 Operating random vibration

The test consists of 30 minutes of random vibration using the power spectral density (PSD) levels specified in the table below. The vibration test level is 0.67 Gs RMS. The drive operates without a hard error while being subjected to the following vibration levels.

Table 4: Operating random vibration profile

Frequency (Hz)	G ² /Hz
17	1.1 x E-03
45	1.1 x E-03
48	8.0 x E-03
62	8.0 x E-03
65	1.0 x E-03
150	1.0 x E-03
200	5.0 x E-04
500	5.0 x E-04

2.8.6.3 Nonoperating sweep sine vibration

The following table lists the maximum nonoperating sweep sine vibration levels that the drive may experience while meeting the performance standards specified. It consists of a forward and backward sweep from 5 Hz to 500 Hz to 5 Hz. The drive does not incur any physical damage when subsequently put into operation.

10 Hz to 500 Hz @ 0.5 oct/min	5.0 Gs (0 to pk). Maximum displacement may apply below 22 Hz.
5 Hz to 10 Hz	25.4 mm peak to peak displacement.

2.8.6.4 Nonoperating random vibration

The test consists of 15 minutes of random vibration using the power spectral density (PSD) levels specified in the table below. The vibration test level is 3.01 Gs RMS. The drive does not incur any physical damage when subsequently put into operation.

Table 5: Nonoperating random vibration profile.

Frequency (Hz)	G ² /Hz
2.5	1.0 x E-03
5	3.0 x E-02
40	1.8 x E-02
500	1.8 x E-02

2.8.7 Corrosive environment

Seagate electronic drive components pass accelerated corrosion testing equivalent to ten years of exposure to light industrial environments containing sulfurous gases, chlorine and nitric oxide, classes G and H per ASTM B845. However, this accelerated testing cannot duplicate every potential application environment.

Users should use caution exposing any electronic components to uncontrolled chemical pollutants and corrosive chemicals as electronic drive component reliability can be affected by the installation environment. The silver, copper, nickel and gold films used in Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or exposed to an ambient relative humidity greater than 95 percent. Materials used in cabinet fabrication, such as vulcanized rubber, that can outgas corrosive compounds should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.

2.9 Acoustics

Drive acoustics are measured as overall A-weighted acoustic sound power levels (no pure tones). Discrete tone penalties are added to the A-weighted sound power (LW) with the following formula only when determining compliance:

$$LWt(spec) == LW + 0.1Pt + 0.3 < 4.0 \text{ (Bels)}$$

where

LW = A-weighted sound power level

pt == Value of discrete tone penalty [$=dLt-6.0$ (dBA)]

dLt = Tone-to-noise ratio taken in accordance with ISO 7779 at each octave band.

All measurements are consistent with ISO document 7779. Sound power measurements are taken under essentially free-field conditions over a reflecting plane. For all tests, the drive is oriented with the cover facing upward.)

Table 6: Drive level acoustics

Acoustic mode	
Idle	Operational
1.6 bels (typ)	2.2 bels (typ)

2.10 Electromagnetic immunity

When properly installed in a representative host system, the drive operates without errors or degradation in performance when subjected to the radio frequency (RF) environments defined in the following table:

Table 7: Electromagnetic immunity

Test	Description	Performance level	Reference standard
Radiated RF immunity	80 to 1,000 MHz, 3 V/m, 80% AM with 1 kHz sine 900 MHz, 3 V/m, 50% pulse modulation @ 200 Hz	A	EN 61000-4-3: 96 ENV 50204: 95
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN 61000-4-5: 95
Conducted RF immunity	150 kHz to 80 MHz, 3 Vrms, 80% AM with 1 kHz sine	A	EN 61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN 61000-4-11: 94

2.11 Reliability

Measurement type	Specification
Nonrecoverable read errors	1 per 10^{14} bits read, max.
Load/Unload (LUL) cycles	300,000 software-controlled 20,000 power loss
Power On Hours (POH) per year	500 hours
Warranty	Per agreement

2.12 Agency certification

2.12.1 Safety certification

The drives are recognized in accordance with UL60950-1, CAN/CSA-C22.2 No.60950-1, EN60950 and IEC 60950.

2.12.2 Electromagnetic compatibility

Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (89/336/EEC). Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55022, Class B and the immunity levels are defined by EN 55024.

Seagate uses an independent laboratory to confirm compliance with the EC directives specified in the previous paragraph. Drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports. Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products.

Korean RRL

If these drives have the Korea Ministry of Information and Communication (MIC) logo, they comply with paragraph 1 of Article 11 of the Electromagnetic Compatibility control Regulation and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Ministry of Information and Communication Republic of Korea.

These drives have been tested and comply with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class B products. Drives are tested in a representative, end-user system by a Korean-recognized lab.

- Family name: Lyrion Series
- Certificate numbers: STX-S181 (B)

Australian C-Tick (N176)

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZS3548 1995 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

2.12.3 European Union Restriction of Hazardous Substances (RoHS) Directive

Seagate designs its products to meet environmental protection requirements worldwide, including regulations restricting certain chemical substances. A new law, the European Union Restriction of Hazardous Substances (RoHS) Directive, restricts the presence of chemical substances, including Lead, Cadmium, Mercury, Hexavalent Chromium, PBB and PBDE, in electronic products, effective July 2006. This drive is manufactured with components and materials that comply with the RoHS Directive.

2.12.4 China Restriction of Hazardous Substances (RoHS) Directive

2.12.4 中国限制危险物品的指令

This product has an Environmental Protection Use Period (EPUP) of 20 years. The following table contains information mandated by China's "Marking Requirements for Control of Pollution Caused by Electronic Information Products" Standard.



该产品具有20年的环境保护使用周期（EPUP）。下表包含了中国“电子产品所导致的污染的控制的记号要求”所指定的信息。

Name of Parts 部件名称	Toxic or Hazardous Substances or Elements有毒有害物质或元素					
	Lead 铅 (Pb)	Mercury 汞 (Hg)	Cadmium 镉 (Cd)	Hexavalent Chromium 六价铬 (Cr6+)	Polybrominated Biphenyl 多溴联苯 (PBB)	Polybrominated Diphenyl Ether 多溴二苯醚 (PBDE)
PCBA	X	O	O	O	O	O
HDA	X	O	O	O	O	O

"O" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is lower than the threshold defined by the China RoHS MCV Standard.

“O”表示该部件（于同类物品程度上）所含的危险和有毒物质低于中国RoHS MCV标准所定义的门槛值。

"X" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is over the threshold defined by the China RoHS MCV Standard.

“X”表示该部件（于同类物品程度上）所含的危险和有毒物质超出中国RoHS MCV标准所定义的门槛值。

2.12.5 FCC verification

These drives are intended to be contained solely within a personal computer or similar enclosure (not attached as an external device). As such, each drive is considered to be a subassembly even when it is individually marketed to the customer. As a subassembly, no Federal Communications Commission verification or certification of the device is required.

Seagate Technology LLC has tested this device in enclosures as described above to ensure that the total assembly (enclosure, disc drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J, Part 15 of the FCC rules. Operation with noncertified assemblies is likely to result in interference to radio and television reception.

Radio and television interference. This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception.

This equipment is designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television, which can be determined by turning the equipment on and off, you are encouraged to try one or more of the following corrective measures:

- Reorient the receiving antenna.
- Move the device to one side or the other of the radio or TV.
- Move the device farther away from the radio or TV.
- Plug the computer into a different outlet so that the receiver and computer are on different branch outlets.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems*. This booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

3.0 Configuring and mounting the drive

This section contains the specifications and instructions for configuring and mounting the drive.

3.1 Handling and static discharge precautions

After unpacking, and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

Caution:

- Do not cover or seal the breather hole! Covering or sealing the breather hole may result in loss of data.

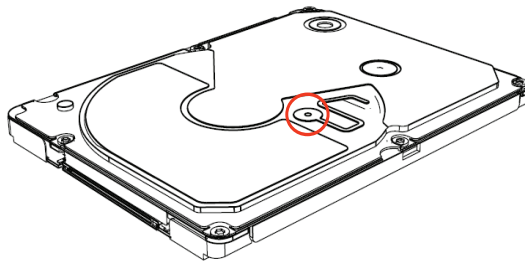


Figure 5. Lyrion Series breather hole location

- Keep the drive in the electrostatic discharge (ESD) bag until you are ready for installation to limit the drive's exposure to ESD.
- Before handling the drives, put on a grounded wrist strap, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.
- Handle the drive only by its edges or frame.

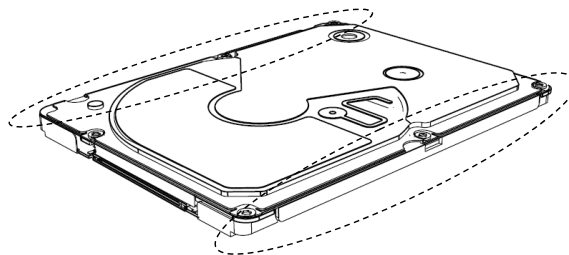


Figure 6. Lyrion Series proper handling example

- The drive is fragile—handle it with care. Do not press down on the drive top cover or attempt to use a pen to write on the drive's label.
- Do not apply more than 6.8N of force to the top cover.
- Always rest the drives on a padded, antistatic surface until you mount it in the system.

- Do not remove the factory-installed labels from the drive or cover them with additional labels. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive. Other labels are used to seal out dirt and contamination.
- If provided, store drive in the protective casing when not in use.
- Turn the power off before installing or removing the drive.
- Do not apply any force to the drive during handling or installation.
- Do not touch the connector pins or the printed circuit board.
- Do not drop the drive.
- Do not expose the drive to wet conditions.
- Do not place the drive near a strong magnetic field.
- Do not expose the drive to extreme temperatures.
- The drive may become hot during operation. Be careful when removing the drive from the host device immediately after operation.

3.2 Drive installation

See Figure 7 for drive mechanical dimensions.

Follow these installation precautions when inserting the drive:

- Follow instructions for the installation of data storage devices, provided with your device's user manual.
- Do not obstruct the breather hole on the drive (see Figure 5).
- Handle the drive only by its edges or frame or designated finger grip region during mounting (see Figure 6).

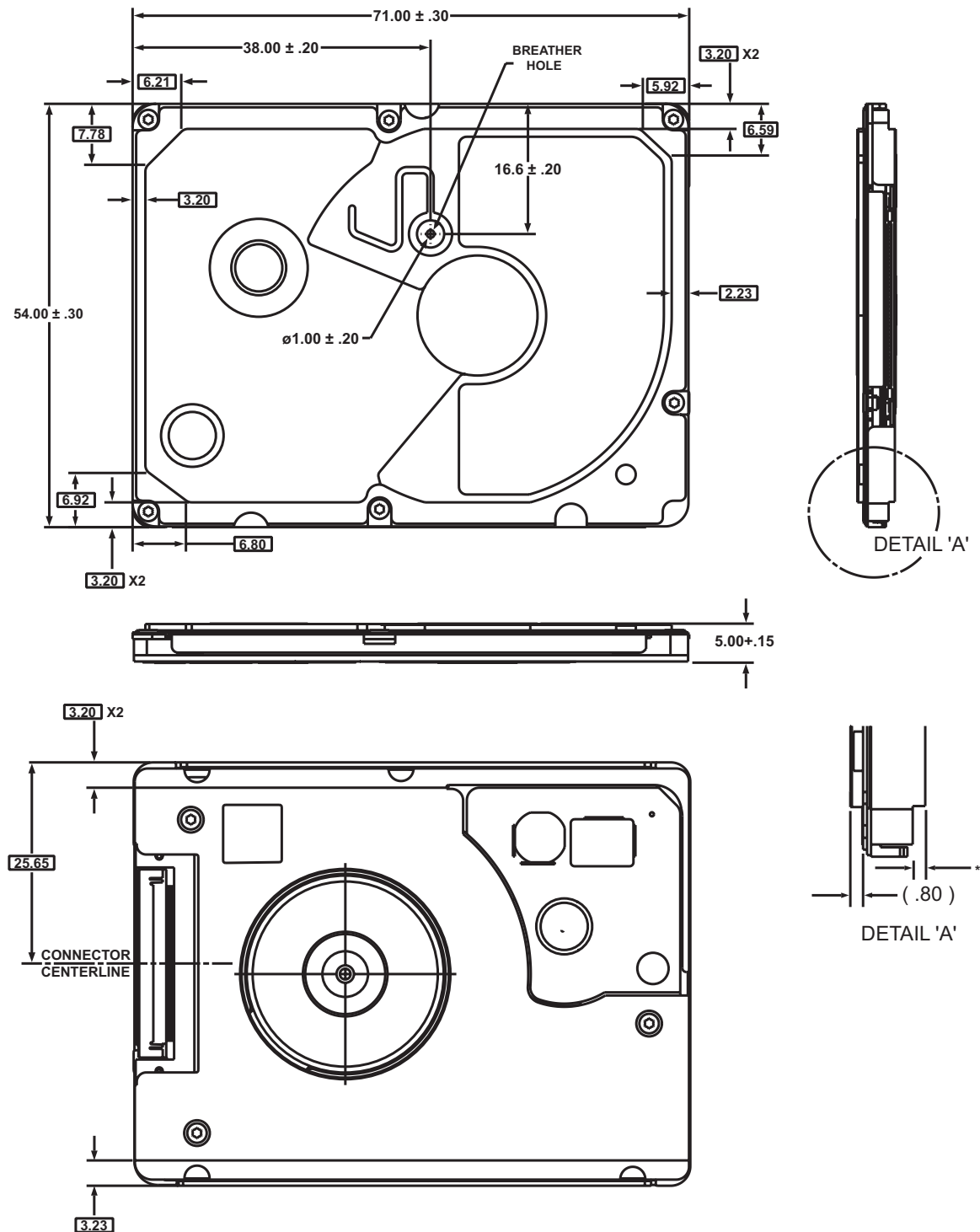


Figure 7. Lyrion Series mechanical dimensions—top, side and end view

3.3 Mounting considerations

- Use an elastic mounting material to protect drives so as to ensure that more shock can be absorbed.
- There are guides along the side for mounting. Refer to figure on areas (refer to Figure 8, shaded area) where the mounting material can rest for mounting.
- As the drive is a sensitive device, it is not recommended to have any mounting force on the top and bottom surface of the drive other than the recommended mounting surfaces. Mounting force on non recommended surfaces shall not exceed 6.8N.”
- The drive can be operated in any orientation but horizontal or vertical orientation is preferred.
- Allow a minimum clearance of 0.012 inches (0.30 mm) around the entire perimeter of the drive for cooling, with the exception of the mounting edges for better airflow.
- In case the system design warrants bending of the FPC to the hard disc drive, care should be taken to maximize the radius.
- Mounting materials are available from many third-party vendors.
- The 40-way connector is design to meet minimum 6N Horizontal FPC retention after mating.
- The connector has a specification of 20 insertion cycles.

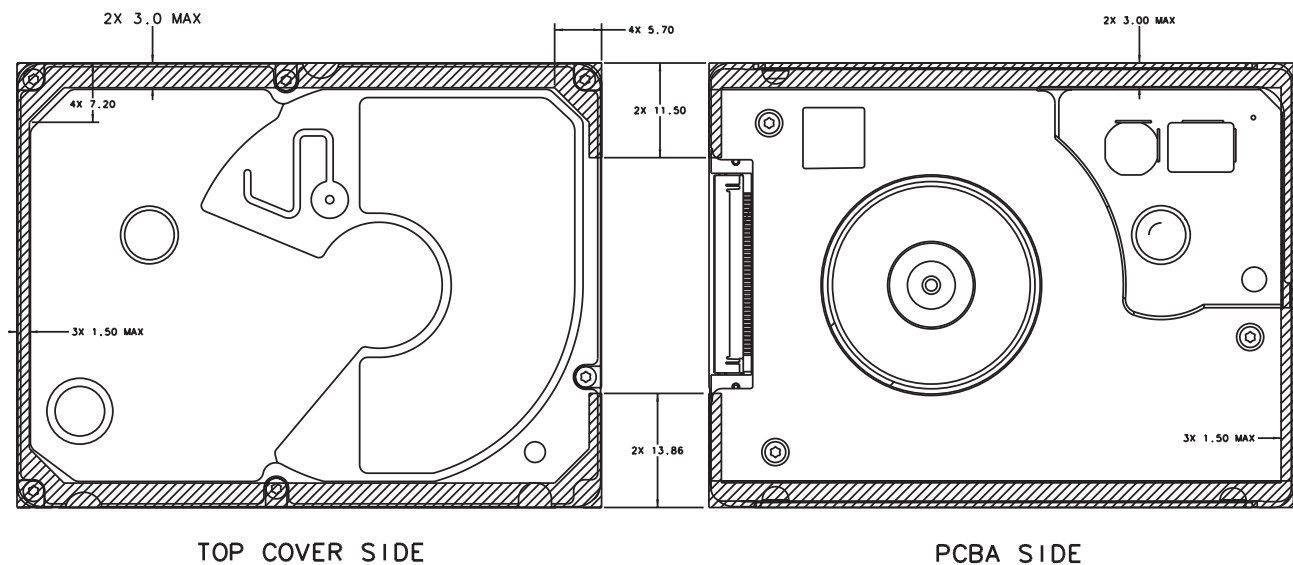


Figure 8. Lyrion Series Area for Protective Mounting

4.0 Interface description

The drives use the industry-standard ATA (IDE) interface. It supports ATA programmed input/output (PIO) modes 0–4; multiword DMA modes 0–2, and Ultra DMA modes 0–4.

4.1 Connector interface signals and connector pins

The following table summarizes the signals on the 40-way ZIF ATA interface connector.

Table 8: 40-way ZIF (IDE interface) connector signals

Pin number	Signal Name	Description
1	Reserved	-
2	Reserved	-
3	RESET-	Hard Reset
4	GROUND	Ground
5	DD07	Data bus bit 7
6	DD08	Data bus bit 8
7	DD06	Data bus bit 6
8	DD09	Data bus bit 9
9	DD05	Data bus bit 5
10	DD10	Data bus bit 10
11	DD04	Data bus bit 4
12	DD11	Data bus bit 11
13	DD03	Data bus bit 3
14	DD12	Data bus bit 12
15	DD02	Data bus bit 2
16	DD13	Data bus bit 13
17	DD01	Data bus bit 1
18	DD14	Data bus bit 14
19	DD00	Data bus bit 0
20	DD15	Data bus bit 15
21	GROUND	Ground
22	DMARQ	DMA request
23	GROUND	Ground
24	DIOW- / STOP	I/O Write to write to device registers or the data port Stop during Ultra DMA burst
25	DIOR- / HDMARDY- / HSTROBE	I/O Read to read device registers or the data port Flow control during Ultra DMA data-in burst Data-out strobe signal for Ultra DMA data-out burst
26	GROUND	Ground

Table 8: 40-way ZIF (IDE interface) connector signals

27	IORDY / DDMARDY- / DSTROBE	I/O Channel Ready during register access Flow control during Ultra DMA data-out burst Data-in strobe signal for Ultra DMA data-in burst
28	GROUND	Ground
29	DMACK-	DMA Acknowledge
30	INTRQ	Interrupt Request
31	DA01	Address bus bit 1
32	PDIAG-	-
33	DA00	Address bus bit 0
34	DA02	Address bus bit 2
35	CS0-	Chip Select 0
36	CS1-	Chip Select 1
37	DASP-	Used to drive external LED when drive is accessed
38	3.3V	Voltage input
39	3.3V	Voltage input
40	Reserved	-

4.2 Supported ATA commands

The following table lists ATA-standard commands that the drive supports. For a detailed description of the ATA commands, refer to ATA version 7 specification, Volume 1. (www.t13.org)

Table 9: Supported commands

Command Name	Command Op-Code	Command Type
NOP	00h	Non data
Recalibrate	10h	Non data
Read Sector(s)	20h	PIO data-in
Read Sector(s) Ext	24h	PIO data-in
Read DMA Ext	25h	DMA data-in
Read Native Max Address Ext	27h	Non data
Read Multiple Ext	29h	PIO data-in
Write Sector(s)	30h	PIO data-out
Write Sector(s) Ext	34h	PIO data-out
Write DMA Ext	35h	DMA data-out
Set Max Address Ext	37h	Non data
Write Multiple Ext	39h	PIO data-out
Read Verify Sector(s)	40h	Non data
Read Verify Sector(s) Ext	42h	Non data
Seek	70h	Non data
Execute Drive Diagnostics	90h	Non data
Download Microcode	92h	PIO data-out
SMART	B0h	
SMART Disable Operations		Non data
SMART Enable/Disable Autosave		Non data
SMART Enable Operations		Non data
SMART Execute Off-Line Immediate		Non data
SMART Read Data		PIO data-in
SMART Read Log		PIO data-in
SMART Return Status		Non data
SMART Write Log		PIO data-out
Device Configuration	B1h	
Device Configuration Restore		Non data
Device Configuration Freeze Lock		Non data
Device Configuration Identify		PIO data-in
Device Configuration Set		PIO data-out
Read Multiple	C4h	PIO data-in
Write Multiple	C5h	PIO data-out
Set Multiple Mode	C6h	Non data
Read DMA	C8h	DMA data-in

Table 9: Supported commands

Write DMA	CAh	DMA data-out
Standby Immediate	E0h	Non data
Idle Immediate	E1h	Non data
Standby	E2h	Non data
Idle	E3h	Non data
Read Buffer	E4h	PIO data-in
Check Power Mode	E5h	Non data
Sleep	E6h	Non data
Flush Cache	E7h	Non data
Write Buffer	E8h	PIO data-out
Identify Device	ECh	PIO data-in
Set Features	EFh	Non data
Security Set Password	F1h	PIO data-out
Security Unlock	F2h	PIO data-out
Security Erase Prepare	F3h	Non data
Security Erase Unit	F4h	PIO data-out
Security Freeze Lock	F5h	Non data
Security Disable Password	F6h	PIO data-out
Read Native Max Address	F8h	Non data
Set Max Address	F9h	Non data

4.2.1 Identify Device command

The Identify Device command (command code EC_H) transfers information about the drive to the host following power up. The data is organized as a single 512-byte (256 word) block of data, whose contents are as shown in the following table.

Word	ATA specification	Value
0	General configuration information bit-significant information Bit 15: 0 = ATA device Bit 7: 1 = removable media Bit 6: 1 = non-removable/fixed device	0040h
10–19	Serial number: (20 ASCII characters)	Serial number
23–26	Firmware revision (8 ASCII character string)	Firmware revision
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	Model number
47	Bits 7-0: Maximum number of sectors transferred per interrupt on Read Multiple/ Write Multiple commands	8010h
49	Capabilities Bit 13: 1= Standby timer values specified in ATA-7 are supported Bit 11: 1= IORDY supported Bit 10: 0= IORDY may not be disabled Bit 9 : 1= LBA supported Bit 8 : 1= DMA supported	2B00h
53	Bit 2: 1= the fields reported in word 88 are valid Bit 1: 1= the fields reported in words (70:64) are valid	0007h
59	Bit 8: 1= Multiple sector setting is valid Bits 7-0: Current setting for number of sectors transferred during a Read/Write Multiple command	0110h
60–61	Total number of user-addressable LBA sectors available	37E3E40h (30GB) 6FC7C80h (60GB)
63	Bit 10: 1= Multiword DMA mode 2 is selected 0= Multiword DMA mode 2 is not selected Bit 9: 1= Multiword DMA mode 1 is selected 0= Multiword DMA mode 1 is not selected Bit 8: 1= Multiword DMA mode 0 is selected 0= Multiword DMA mode 0 is not selected Bit 2: 1= Multiword DMA mode 2 and below are supported Bit 1: 1= Multiword DMA mode 1 and below are supported Bit 0: 1= Multiword DMA mode 0 is supported	xxx7h
64	Bits 7-0: PIO modes supported	0003h
65	Minimum Multiword DMA transfer cycle time per word Bits 15-0: Cycle time in nanoseconds	0078h
66	Recommended Multiword DMA transfer cycle time Bits 15-0: Cycle time in nanoseconds	0078h
67	Minimum PIO transfer cycle time without flow control Bits 15-0: Cycle time in nanoseconds	0078h
68	Minimum PIO transfer cycle time with IORDY flow control Bits 15-0: Cycle time in nanoseconds	0078h

82	Command sets supported Bit 14: 1= NOP command supported Bit 13: 1= READ BUFFER command supported Bit 12: 1= WRITE BUFFER command supported Bit 10: 1= Host Protected Area feature set supported Bit 6: 1= Look-ahead supported Bit 5: 1= Write cache supported Bit 3: 1= Mandatory Power Management feature set supported Bit 1: 1= SECURITY Mode feature set supported Bit 0: 1= SMART feature set supported	746Bh
83	Command sets supported Bit 13: 1= FLUSH CACHE EXT command supported Bit 12: 1= Mandatory FLUSH CACHE command supported Bit 11: 1= DEVICE CONFIGURATION overlay feature set supported Bit 10: 1= 48-bit Address feature set supported Bit 8: 1= SET MAX security extension supported Bit 5: 1= Power up in Standby feature supported Bit 3: 1= Advanced Power Management feature set supported Bit 0: 1= DOWNLOAD MICROCODE command supported	7D29h
84	Command set/feature supported extension Bit 5: 1= General Purpose Logging feature supported Bit 1: 1= SMART self-test supported Bit 0: 1= SMART error logging supported	6063h
85	Command sets referred in word 82 enabled	xxxxh
86	Command sets referred in word 83 enabled	xxxxh
87	Command set/feature default Bit 5: 1= General Purpose Logging feature supported Bit 1: 1= SMART self-test supported Bit 0: 1= SMART error logging supported	6063h
88	Bit 12: 1= Ultra DMA mode 4 is selected 0= Ultra DMA mode 4 is not selected Bit 11: 1= Ultra DMA mode 3 is selected 0= Ultra DMA mode 3 is not selected Bit 10: 1= Ultra DMA mode 2 is selected 0= Ultra DMA mode 2 is not selected Bit 9: 1= Ultra DMA mode 1 is selected 0= Ultra DMA mode 1 is not selected Bit 8: 1= Ultra DMA mode 0 is selected 0= Ultra DMA mode 0 is not selected Bit 4: 1= Ultra DMA mode 4 and below are supported Bit 3: 1= Ultra DMA mode 3 and below are supported Bit 2: 1= Ultra DMA mode 2 and below are supported Bit 1: 1= Ultra DMA mode 1 and below are supported Bit 0: 1= Ultra DMA mode 0 and below are supported	xx1Fh
91	Current Advanced Power Management value (default)	4040h
100-103	Total number of user-addressable LBA sectors available for 48-bit addressing feature (48-bit addressing not supported)	37E3E40h (30GB) 6FC7C80h (60GB)

4.2.2 Set Features command

This command is used by the host to establish parameters that affect the execution of certain drive features. The supported features determined by the value in the Features register are as shown in Table 11. Read look-ahead and write cache are enabled by default upon power on.

Table 10: Features register values

Feature	Description
02h	Enable Write Cache
03h	Set DMA and PIO transfer modes based on the value in the Sector Count register. Sector Count register values 08h: Set PIO Transfer Mode 0 09h: Set PIO Transfer Mode 1 0Ah: Set PIO Transfer Mode 2 0Bh: Set PIO Transfer Mode 3 0Ch: Set PIO Transfer Mode 4 20h: Set Multiword Transfer Mode 0. 21h: Set Multiword Transfer Mode 1. 22h: Set Multiword Transfer Mode 2. 40h: Set Ultra DMA mode 0. 41h: Set Ultra DMA mode 1. 42h: Set Ultra DMA mode 2. 44h: Set Ultra DMA mode 4.
05h	Enable Advanced Power Management (APM) with APM level as in the Sector Count register . Sector Count register values 0h : Reserved 1h – 7Fh : Allow Spin-Down (Standby Mode) 80h – FEh : Disallow Spin-Down (Standby Mode) FFh : Reserved
55h	Disable Read Look-Ahead.
82h	Disable Write Cache.
85h	Disable Advanced Power Management (APM)
AAh	Enable Read Look-Ahead .

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